Cost-effectiveness approaches in the control of mosquitoes in developing countries:

A case study for Public Health Protection in Uganda & Zambia

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Outline

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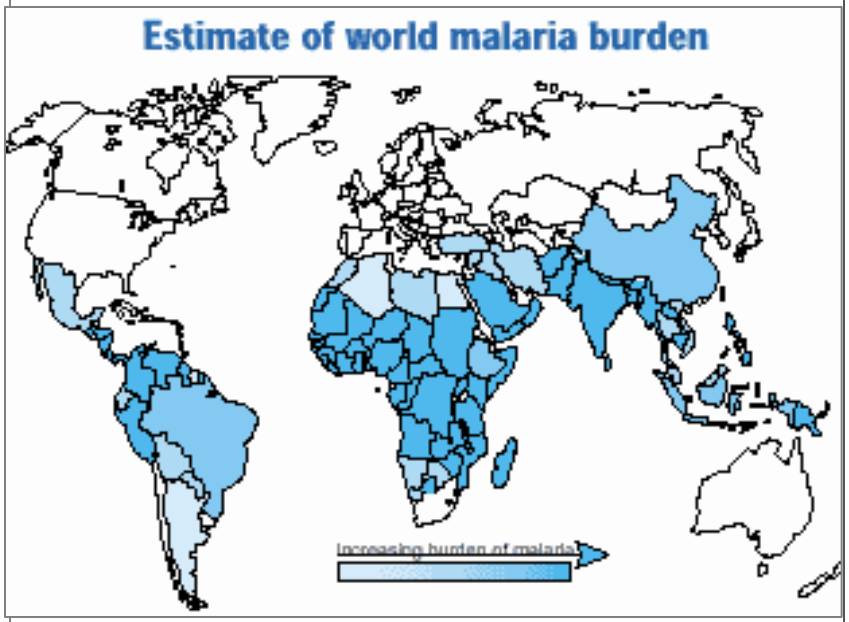
  - Malaria and Lyme disease
- Intervention strategies
  - Malaria and Lyme disease
- **Environmental management /Home Management Malaria**
- Lessons learned/conclusion

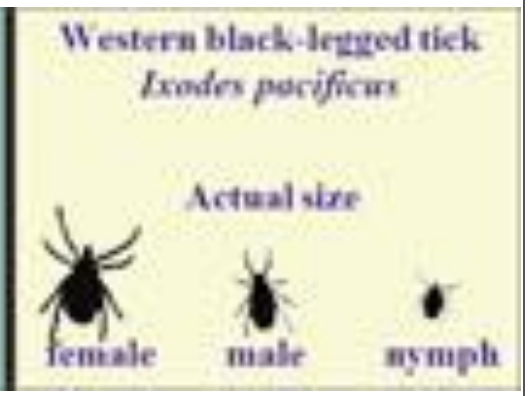


Questions to the audience?

- Are there any historical programs that have been used with the aim to eradicate Malaria or Lyme diseases?
- Were these programs a success or a failure?
  - Discuss Reasons……

Main Objective

- To highlight cost-effective approaches to reduce mosquito infestations and ensure minimal exposure to humans through the analytical evaluation of mosquito behavior and control programs.
- To apply lessons learned from this analytical approach to the control program efforts of Lyme diseases



Introduction

Similarities between Malaria & Lyme diseases

- Both are all transmitted through arthropods (insects or arachnids)
- Ticks & mosquitoes are classified as parasites
  - Transmit diseases to people by blood-sucking
- Both diseases are strongly influenced by environmental factors.
- Both are of important public health parasites to be discussed
- Control of these can be partially attained through the spraying of insecticides or other methods of reducing the insect population such as **Environmental Management**

Malaria

- Malaria caused by one of the 4 types of protozoa is a major health problem in much of the tropics and subtropics.
  - ***It is spread by mosquito bites***
- The CDC estimates: 300-500 million cases of malaria each year, and more than 1 million people die

Problem: Resistant to insecticides

- This has led to difficulty in controlling both the rate of infection and spread of the disease

Lyme disease

- Lyme disease is most common *tick-borne* illness in the northern hemisphere.
  - Caused by infection with a bacterium called *Borrelia burgdorferi*.
    - **Spread by deer ticks bites that harbor the bacterium.**
  - Just like malaria the disease if left undiagnosed, the effects can be devastating.
    - Arthritis and neurologic symptoms

Public Health Protection in Uganda

- Malaria is a major public health problem in Uganda
  - Accounting for 25-40% of all outpatient attendances,
  - 9-14% of admissions and a case fatality rate of 3% in Uganda (Republic of Uganda 2008).

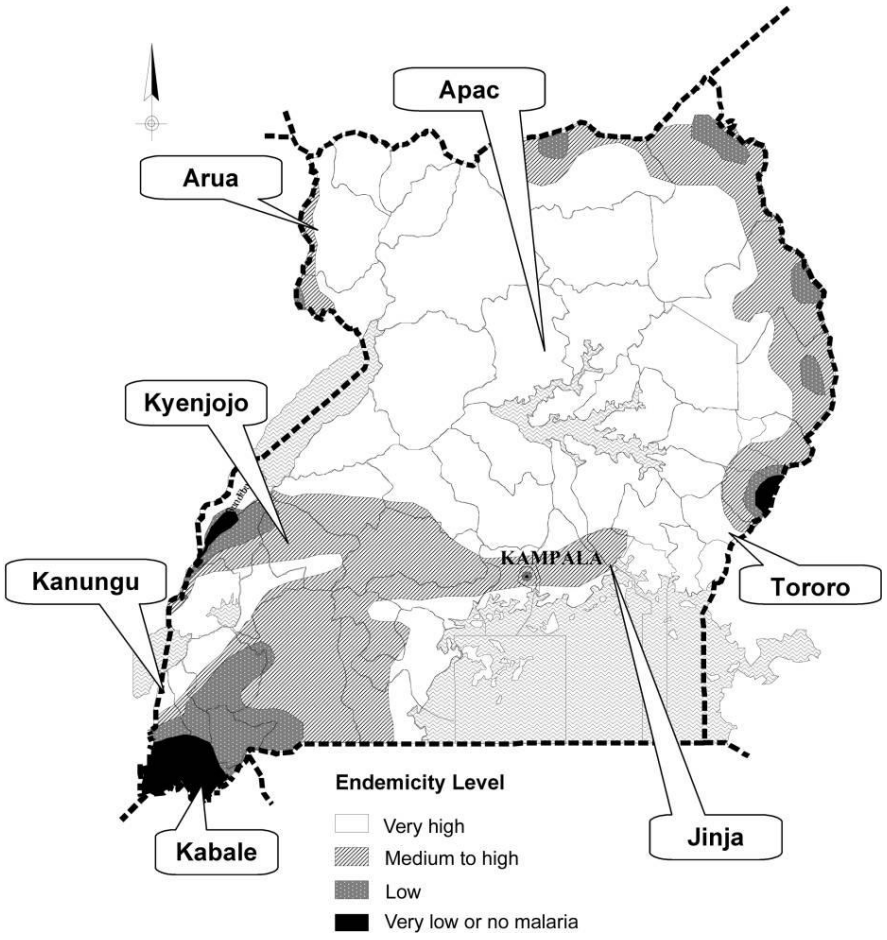


Figure 1. Map of sentinel site health centers

Source: Hopkins et L. 2008

Preventive interventions - malaria

- Strategies recommended for vector management in Uganda are:
  - indoor spraying of houses with residual insecticides (IRS) and
  - insecticide-treated bed nets (ITNs)
  - Treatment through the use of anti-malaria drugs though mosquitoes are becoming drug resistant.

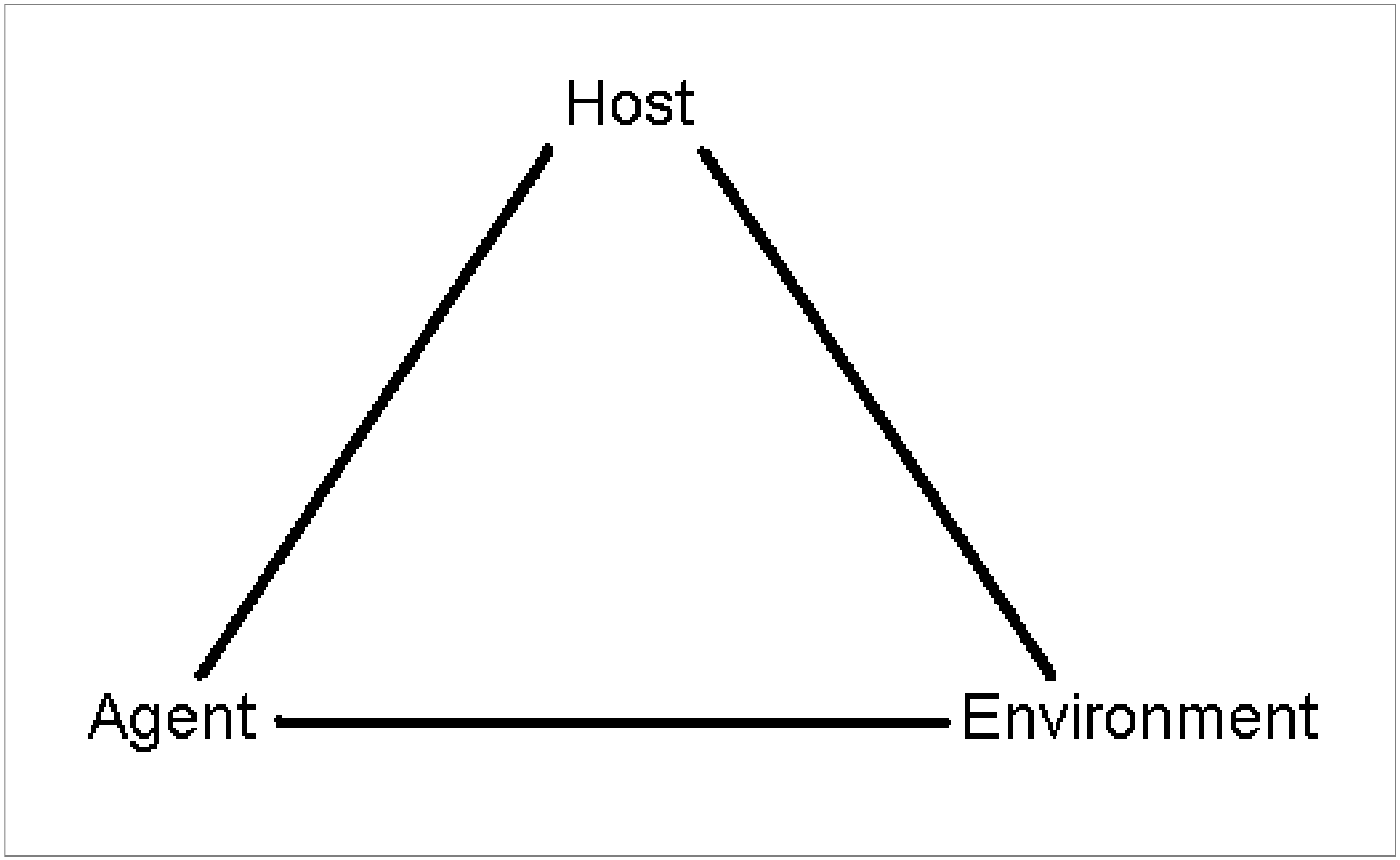
Lyme disease & Malaria control

- Deer tick often hides in shady moist places – this is also true with mosquitoes
  - Vegetation clearance around homes reduces the infestation of mosquitoes + ticks
  - House or yard screening (for mosquitoes, tick identification
  - Environmental management –Target life cycle of both diseases
  - Modification of river boundaries, draining swamps, oil application to open water bodies
- Both malaria and Lyme diseases can be treated if diagnosed early so see a physician as early as possible

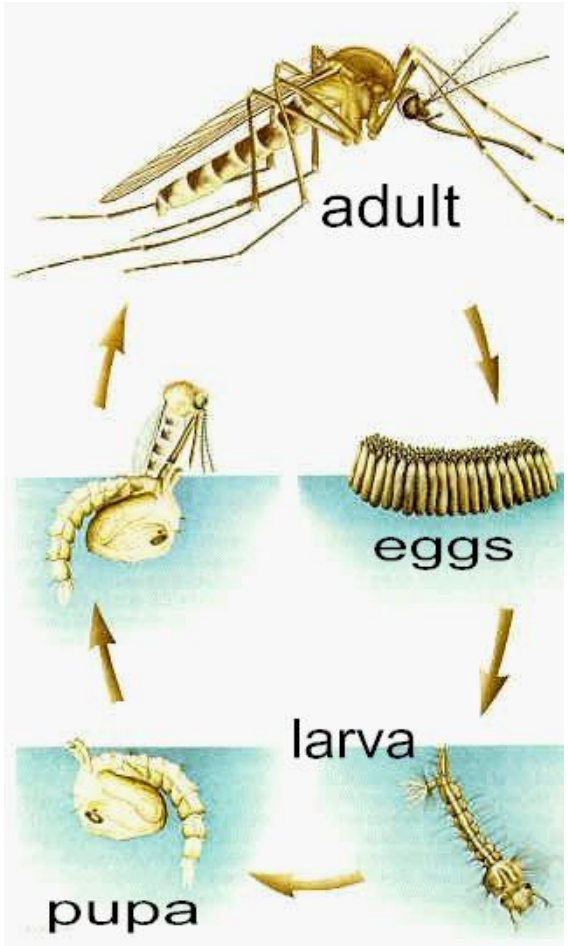
Treatment of – Lyme disease | Malaria

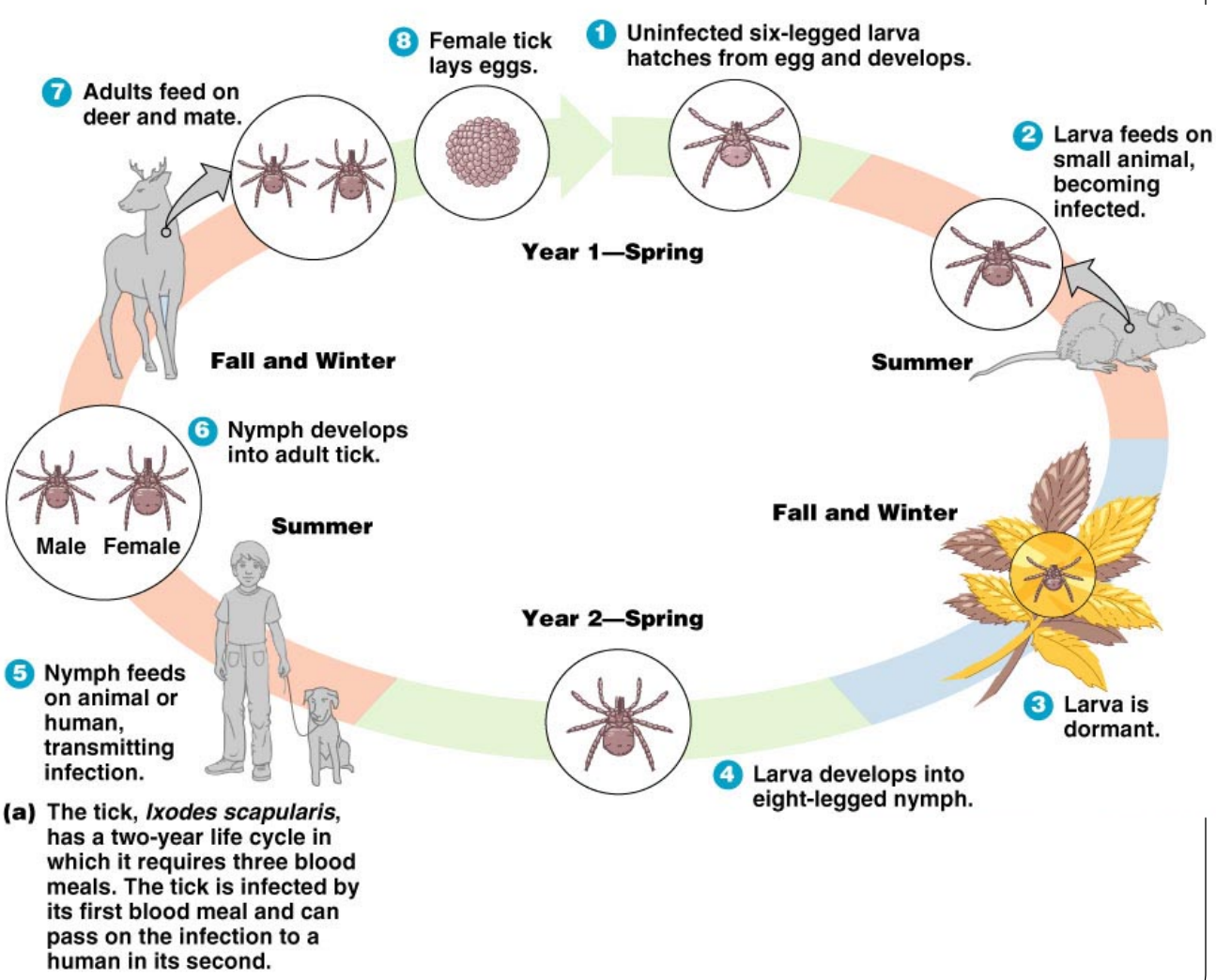
- Treatment of Lyme disease mostly with antibiotics.
- Long term use of anti-malaria drug or antibiotics for Lyme disease can have the following consequences:
  - Costly
  - Inefficient and potentially harmful
    - Due to drug-resistant conditions
  - What are cost-effective preventative and control measures being used in malaria control that could be part of lessons to be applied to Lyme disease control?

Environmental Management to control Malaria



Understanding the Life cycle of the diseases

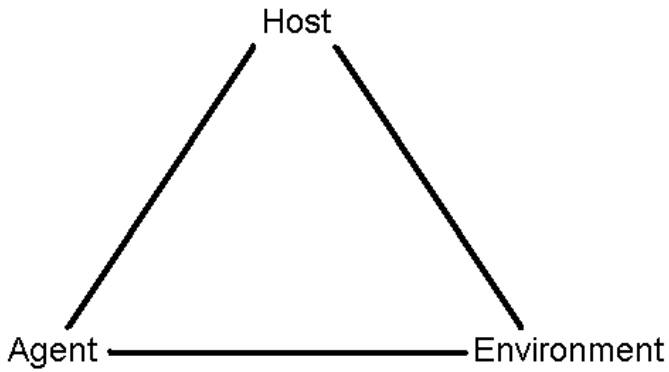




(a) The tick, *Ixodes scapularis*, has a two-year life cycle in which it requires three blood meals. The tick is infected by its first blood meal and can pass on the infection to a human in its second.

Cost-effectiveness of environmental management
Roll back malaria (RBM) : Case study of Zambia
(Utzinger, et al. 2001)

- RBM – (1998) aimed at halving the burden of malaria by the year 2010
- (Using Lessons learned from historical data.) HOW?



- Data Assembled (1929-1949):

- **Results:**
  - 3-5 Yrs
  - 70±95% low malaria related mortality, morbidity and incidence rates
- Estimated costs per disability adjusted life year (DALY) averted
  - were US$ 524±591.
- Within 20 years
  - Estimated 4173 deaths and 161 205 malaria attacks.
  - Estimated costs per death and malaria attack [US$ 858 and US$ 22.20 respectively]

Community low cost control measures Case study of Uganda

- Community-implemented malaria control programme
  - Tailored strategy to the prevailing ecological & epidemiological conditions
  - Understanding the ecological conditions which affect & regulate the distribution and abundance of mosquito populations.
    - Local priorities depends on local resources in order to have sustainable program (through the support of government agencies).
  - Home Management of Malaria

Community low cost control measures – Case study of Uganda

- Home Management of Malaria
  - Providing training of the community members as medicine distributors (travel cost reduction to clinics)
  - Distribution of anti-malarial medicines
  - Campaign, and community sensitization to caregivers (Adherence by caregivers, home cleanliness campaign etc.)
- Accessibility of anti-malarial medicine in many villages
  - "bring appropriate drugs closer to home"
  - Availability of anti-malarial medicine at an affordable price

Efforts by Volunteers

- Volunteers from the community (Community Medicine Distributors (CMD) are trained
  - Normally two are selected per village and trained
  - They evaluate and treat febrile children and are provided with ant-malarial drugs to household care takers
- CMDs report to the nearest Health facility for supplies etc.
- This is part of cost-effective since household caretakers don't travel a long distance to seek for emergency treatment
  - Risks are minimized (a journey of 5km to the nearest clinic including poor infrastructure can ultimately reduce preventable conditions and deaths)

Advantages of community low cost control measures

- Likely to be most effective and cost-effective in areas with high malaria transmission
- Limited health care infrastructure
- Poor access to ant-malarial treatment
- Communities understand that malaria is the main killer disease therefore becomes excited to participate.

- Lubell, et al. 2010

Funding of community based control programs

- National Malaria Control Programme (NMCP) & MoH
- Private Sector in Uganda
- Non-governmental organizations
- WHO-Geneva through the Makerere University
- U.S. President's Malaria Initiative (PMI)
- UNICEF-UNDP-WORLD BANK-WHO Special Programme for Research and Training in Tropical Diseases (TDR)

Difference between Uganda & US

- The control program of these diseases are scientific, technical activity that requires skilled personnel
  - The majority of Ugandans are not well educated compared to US so this can have different settings
- Availability of local resources will dictate local priorities.
- Funding is a problem and as a result in Uganda most villages rely on community efforts to sustain their programs.

Lessons learned

- Considering the similarities of the behavior of mosquitoes and ticks behavior employing both prevention interventions combined with alternative low cost strategies can help to reduce malaria and Lyme diseases.
  - Community efforts in Uganda can be a foundation for further research that could help to develop effective local strategies that can ensure sustainability.
  - Historical studies can help to modify strategies to control mosquitoes and likely ticks infestation.

Conclusion

- Ticks, and mosquitoes will continue to be important public health parasites for discussions.
- Effective control measures will not only be measured by the effectiveness of a particular method or combination of methods, but also in the methodology that will ensure sustainability and minimal exposure to humans.
- Community involvement & institutional participation could also strengthen the control measures.
- Environmental management has a long-term track record of successful malaria control in a diversity of ecological, epidemiological and socio-economic settings.
- Specific control strategies should be developed for specific country conditions

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Thank you

Discussions